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BALDCYPRESS, *TAXODIUM DISTICHUM* (CONIFERALES: TAXODIACEAE), A PRIMARY FOOD SOURCE OF GYPSY MOTH, *LYMANTRIA DISPAR,* IN MARYLAND (LEPIDOPTERA: LYMANTRIIDAE)

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Abstract.—We observed gypsy moths, *Lymantria dispar,* feeding on baldcypress, *Taxodium distichum* during 1987 on the Maryland portion of the Del-Mar-Va peninsula. This is the first record of baldcypress as a natural food source of gypsy moths. Three sites dominated by baldcypress (>50%) in Worcester County, Maryland were sampled during 1989 to determine whether gypsy moths could utilize this species as a primary food source and for oviposition sites. Gypsy moth larvae fed readily on baldcypress needles in the laboratory, and underwent metamorphosis, mated and oviposited on an exclusive diet of this deciduous conifer. The average number of egg masses per tree (at two sites) increased from 5.5 to 10.5 (a 95% increase) between March and September 1989. Seventy-seven percent of laboratory reared larvae fed exclusively on baldcypress needles, completed larval development and emerged as adults.

Key Words: Lepidoptera, Lymantriidae, *Lymantria dispar,* gypsy moth, *Taxodium distichum,* baldcypress, Maryland

The gypsy moth, *Lymantria dispar,* was first reported in Maryland (Cecil County) in 1969 and has subsequently spread statewide. Although gypsy moth larvae prefer oaks (*Quercus* spp.) as their primary host, they are polyphagous and will feed on a variety of different plant species if oaks are not available (Johnson and Lyon 1988). For example, Forbush and Fernald (1896) found 458 different plant species acceptable as hosts, whereas Mosher (1915) tested 152 different hosts and concluded that most conifers were unsatisfactory food sources, including baldcypress. Rossiter (1987) studied the utilization of pitch pine, *Pinus rigida* Miller, as food source for the gypsy moth and found that later instars were able to feed successfully on this evergreen conifer. Doskotch et al. (1977) and Jermy et al. (1968) found several other conifers that served as a primary food source for gypsy moth larvae. Based on gypsy moth feeding responses to plant extracts, Doskotch et al. (1977) categorized 29 plant species as either "stimulant" hosts (>50% feeding rate), or "neutral" hosts (<50% feeding rate). They considered baldcypress a "neutral" host. There are several recent records of gypsy moth larvae feeding on conifers in the northwestern United States (Miller and Hanson 1989, Joseph 1990, Miller et al. 1991). Miller and Hanson (1989) tested three native North American species of Taxodiaceae as suitable hosts for gypsy moth. They found that Redwood (*Sequoia sempervirens*) and Giant sequoia (*Sequoiadendron*

gigantea) were suitable hosts, whereas Dawn redwood (Metasequoia glyptostroboides) was not suitable.

Baldcypress is injured by several insects but damage is usually minor (Goyer and Lenhard 1988), and this species is considered to be relatively free of severe insect pests (Elias 1980). Bagworm (*Thyridopteryx ephemeraeformis*) is a common defoliator of baldcypress in Maryland and Delaware during late summer and early fall, but defoliation by this species is apparently never complete and damage is usually minimal (personal observation). The cypress looper (*Anacamptodes pergacilis*) is known to cause significant damage to needles of baldcypress periodically in Arkansas, Georgia, Florida and Maryland (Baker 1972, Johnson and Lyon 1988). The fruit tree leafroller, (*Archips argyrospila*), previously unknown as a pest of baldcypress, became epidemic on this species in southern Louisiana in 1983 (Goyer and Lenhard 1988). Goyer and Lenhard (1988) reported severe defoliation of baldcypress by this leafroller with some dieback, but no mortality in mature trees. All other known pests of baldcypress either damage cones or other plant parts but do not cause defoliation (Wilhite and Toliver 1990).

During 1987 we discovered gypsy moth larvae feeding extensively on baldcypress within the floodplain of the Pocomoke River in Worcester County, Maryland. This paper documents the first record of gypsy moth utilizing baldcypress as a natural primary host and reports observations on natural populations and laboratory reared larvae feeding on this plant species.

Materials and Methods

We studied natural populations of gypsy moth on baldcypress at three sites selected during March 1989 in Worcester County, Maryland. These sites are: (1) Furnace Town, on Furnace Town Road, 6.4 km NW of Snow Hill; (2) Millville Road off Furnace Town Road, 7.7 km NW of Snow Hill and 1.3 km N of Furnace Town Road; and (3) Liberty Town Road, 12.5 km N of Berlin. Criteria for site selection were >50% baldcypress per stand and >200 egg masses per site based on a 1/40 acre survey. A 1/40 acre survey was conducted during the initial March 1989 visit to determine egg mass density. Sites were visited weekly from mid-April (hatching) to late June (pupation) to further monitor larval development and extent of defoliation.

In early April 1989, we collected ten egg masses from site 1 and cleaned them with air drawn through a 20 mesh screen by electric vacuum to remove setae and other debris (Tardif and Secrest 1970). Eggs were examined with a dissecting microscope for viability, parasites, and physical damage. Ten eggs were placed in each of ten rearing containers (10 cm covered glass petri dishes). Eggs and rearing containers were sterilized in a 0.25% sodium hypochlorite solution to retard viral, bacterial and fungal growth.

Baldcypress needles were collected from site 1 and sterilized in a 0.25% sodium hypochlorite solution, and introduced to newly hatched larvae. Every third day the chambers were cleaned and new baldcypress needles added. Larvae were examined daily for mortality, and their development monitored. Emerging third instars were transferred to 750 ml glass jars, the amount of baldcypress needles increased to offset increased consumption, and the jars cleaned every two days thereafter. Immediately after pupation, pupae were individually placed in covered plastic cups until adults emerged.

Results

Field study.—Pre-season egg mass surveys from March 1989 were compared to post-season surveys from September 1989. Comparisons between the pre- and post-season total egg mass counts per acre, based on the 1/40 acre survey, for the three sites indicated a significant increase in egg mass density over the 1989 season (Table 1).

Hatching of gypsy moth eggs at all 3 sites was completed by 30 April 1989. All larval

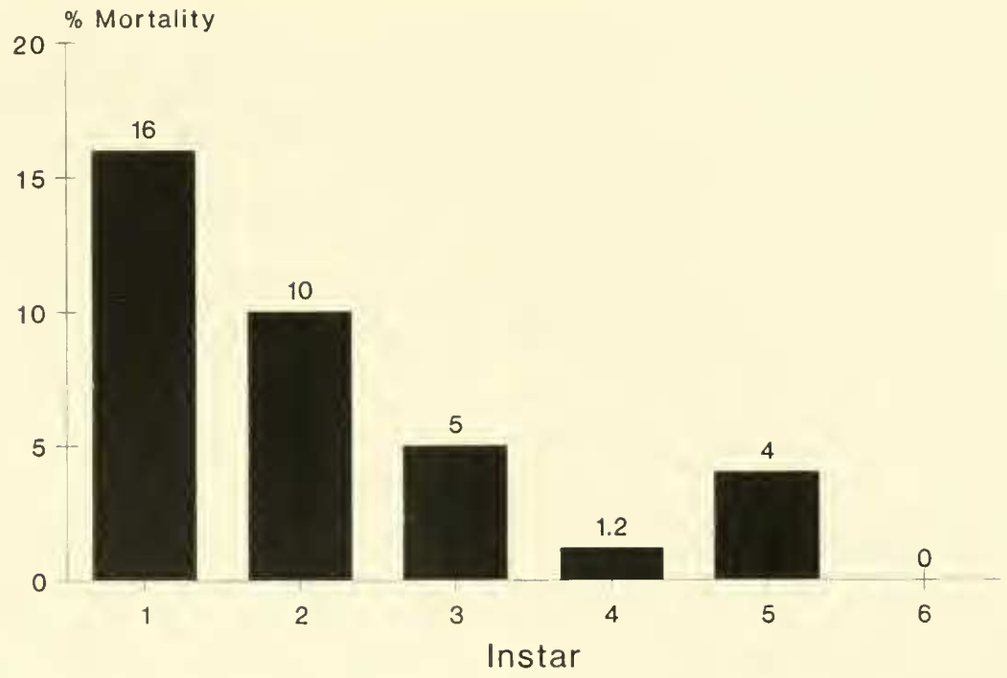

Fig. 1. Mortality rates of gypsy moth larvae reared on baldcypress.

stages were observed feeding on baldcypress and oaks (*Quercus* spp.). Observations of larval development on baldcypress and oak trees at all three study sites indicated that pupation began as early as 8 June on both hosts.

During June 1989, defoliation of immature baldcypress was estimated to be approximately 40%, 30% and 60% at sites 1–3 respectively. Leaf litter and frass was observed at this time at all three sites on the ground surrounding baldcypress trees. Oviposition began in early August at sites 1 & 2, with a combined average of new egg mass numbers of 97 on oak and 84 on baldcypress. During early August 1989, site 3 was severely flooded and unaccessible. Of note was an observation of egg masses deposited on perennially flooded baldcypress trees. This can be explained by the fact that we occasionally observed larvae actively swimming on the surface of the water in flooded areas. Laboratory observations of swimming gypsy moth larvae indicated that they would drown within several hours in glass beakers containing water without branches as purchase sites.

Laboratory study.—Eighty-one of the 100 incubating eggs hatched in the laboratory. Barbosa and Capinera (1977) observed greatest mortality in laboratory reared gypsy moth larvae during the first two instars. Our study produced similar results, with highest mortalities occurring during the first (16%) and second (10%) instars (Fig. 1). Miller and Hanson (1989) established four criteria for distinguishing most suitable hosts for gypsy moths among 39 species of gymnosperms. Their criteria were: 1) >80% survival of 1st instar larvae, 2) development to pupation in <41 days, 3) female pupal weights 1100 mg or greater, 4) production of >350 ova. Since 84% of 1st instar larvae survived in the present study, this indicates

Table 1. Comparison of the total number of gypsy moth egg masses at Worcester County, Maryland, survey sites during March and September 1989.

Site	March 1989		September 1989	
	Total Egg Masses	Average No. Masses per Tree	Total Egg Masses	Average No. Egg Masses per Tree
1. Furnace Town	1160	3	2880	6
2. Millville Rd.	240	8	6480	15
3. Liberty Town Rd.	13,580	30+	*	*

* Site unavailable due to severe flooding of Pocomoke River during late August.

that baldcypress is a potential most suitable host for this criterion as defined by Miller and Hanson (1989). Of the 64 surviving larvae in our present study, all pupated, and 49 emerged as adults (77%). Development to pupation in this study ranged from 46 to 55 days with an average of 47 days, which is longer than the 41 day maximum as defined by Miller and Hanson (1989) for most suitable hosts. Two laboratory reared females mated and oviposited viable fertilized egg masses containing 373 and 291 eggs (avg. 332), which is somewhat lower than the >350 eggs as defined by Miller and Hanson (1989) for most suitable hosts.

Discussion

Comparisons of natural and laboratory reared populations indicate that all larval instars readily feed on baldcypress and are able to utilize this plant as a primary food source. Although weights were not recorded for laboratory reared specimens, no noticeable differences in instar size or development times between natural and laboratory reared larvae were observed. Similarly, adult moths that emerged in the laboratory were comparable to field captured adults morphologically.

Most broadleaf trees can withstand defoliation for several years before decline or death occurs, whereas some conifers can die after one complete defoliation by gypsy moth larvae (Johnson and Lyon 1988, Corliss 1952). Therefore, the potential for extensive damage to the great cypress swamps of the southeastern United States is possible as the gypsy moth continues to extend its range farther south.

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